SCIENCE FOUNDATIONS

Redox reactions

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you explain rust eating a bike chain, a battery charging your phone, and a campfire burning wood, since all of them move electrons from one thing to another. A bike left out in the rain rusts because iron gives electrons to oxygen, and a battery works because it controls that same kind of transfer. A campfire burns because wood gives up electrons to oxygen fast enough to release heat and light. Knowing redox reactions tells you that rust, batteries, and burning are the same kind of event, just running at different speeds.



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Rule

Redox reactions: oxidation is losing electrons and reduction is gaining electrons.

When an oxidation number rises, that species is oxidized, and when it falls, that species is reduced. Oxidation and reduction always happen together.

OIL RIG is a way to remember this: OIL stands for Oxidation Is Losing, and RIG stands for Reduction Is Gaining. The oxidizing agent is the species that is reduced, and the reducing agent is the species that is oxidized.

Worked examples

EXAMPLE 1

Q In Zn + Cu2+ -> Zn2+ + Cu, who is oxidized and who is reduced?

SOLUTION

Track zinc: Zn goes from 0 to + 2, a rise, so it loses electrons.

Track copper: Cu2+ goes to 0, a fall, so it gains electrons.

Label: zinc oxidized, copper reduced.

The result is zinc oxidized, copper ion reduced.

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EXAMPLE 2

Q In $2Mg + O_2 \rightarrow 2MgO$, who is oxidized and who is reduced?

SOLUTION

Track magnesium: Mg goes from 0 to + 2, a rise, so it loses electrons.

Track oxygen: O goes from 0 to - 2, a fall, so it gains electrons.

Label: magnesium oxidized, oxygen reduced.

The result is magnesium oxidized, oxygen reduced.

Practice questions

1 In $Mg + Cu2+ \rightarrow Mg2+ + Cu$, which species is oxidized and which is reduced? Explain using oxidation numbers.

- **A** Magnesium is oxidized (0 to +2); the copper ion is reduced (+2 to 0)
- **B** Magnesium is reduced (+2 to 0); the copper ion is oxidized (0 to +2)
- **C** Magnesium is oxidized (0 to +2); the copper ion is oxidized (+2 to 0)
- **D** Both are oxidized

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2 **In Fe + Cu2+ -> Fe2+ + Cu, what happens to the oxidation number of iron?**

- **A** It rises from 0 to +2
- **B** It falls from +2 to 0
- **C** It rises from +2 to 0
- **D** It stays at 0

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3 **In $2Zn + O_2 \rightarrow 2ZnO$, which species is oxidized and which is reduced? Explain using oxidation numbers.**

- **A** Zinc is oxidized (0 to +2); oxygen is reduced (0 to -2)
- **B** Zinc is reduced (+2 to 0); oxygen is oxidized (0 to -2)
- **C** Zinc is oxidized (0 to +2); oxygen is oxidized (0 to -2)
- **D** Both are reduced

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4 In $2Ca + O_2 \rightarrow 2CaO$, which species gains electrons?

A Oxygen

B Calcium

C Both gain electrons

D Neither gains electrons

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5 What is oxidation?

A Loss of electrons

B Gain of electrons

C Loss of protons

D Gain of protons

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6 What is reduction?

A Gain of electrons

B Loss of electrons

C Gain of protons

D Loss of protons

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7 What does OIL RIG mean?

A Oxidation is loss, reduction is gain

B Oxidation is gain, reduction is loss

C Oxidation is loss, reduction is loss

D Oxidation is gain, reduction is gain

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8

If an oxidation number rises, is that oxidation or reduction?

A Oxidation

B Reduction

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9

What is the oxidizing agent in $Zn + Cu2+ -> Zn2+ + Cu$?

A The copper ion

B Zinc

C The zinc ion

D Copper metal

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10 **What is the reducing agent in Zn + Cu2+ -> Zn2+ + Cu?**

A Zinc

B The copper ion

C The zinc ion

D Copper metal

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ANSWER KEY

1. Magnesium is oxidized (0 to +2); the copper ion is reduced (+2 to 0)

2. It rises from 0 to +2

3. Zinc is oxidized (0 to +2); oxygen is reduced (0 to -2)

4. Oxygen

5. Loss of electrons

6. Gain of electrons

7. Oxidation is loss, reduction is gain

8. Oxidation

9. The copper ion

10. Zinc

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